STS-100

FLIGHT READINESS REVIEW

April 5, 2001

Ground Operations

United Space Alliance

AGENDA

- Shuttle Processing
  - Integrated Operations — J. Vevera
  - Launch and Landing — M. Leinbach
  - Summary — D. King, E. Adamek, C. Murphy

PROCESSING DIFFERENCES

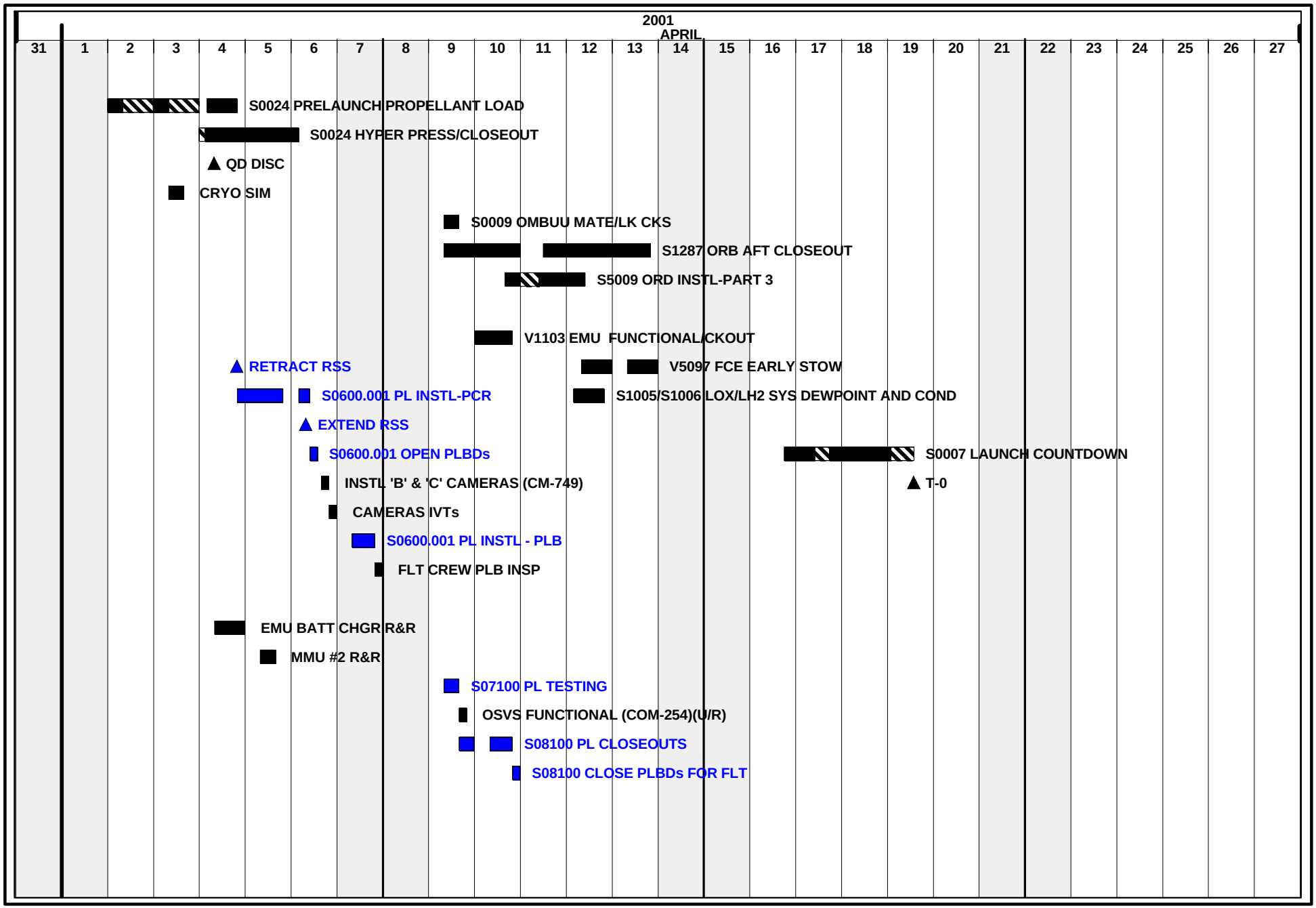
Presenter:
Jim Vevera
Organization/Date:
Ground Ops/04-05-01

- Processing Differences - VAB / Pad
  - Planned
    - Late Payload Installation
    - MMU 2 R&R
  - Unplanned
    - Early Hyper Pressurization
    - Late LH 16 MM Sep Camera Installation

STS-100 / OV-105
Operations Summary

OPR: USA - D. Thompson, INTEG(1-2565)
NASA - E. Mango, PH (1-9221)

28MAR01 14:02



SHUTTLE ENGINEERING OVERVIEW

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

The following Topics have been reviewed:

• Requirements Status – OMRS	No Issues
• TOPS Status	No Issues
• LCC/GLS Status	No Issues
• Software, SCAN, and Configuration Status	No Issues
• Vehicle/GSE Modification Status	No Issues
• In-Flight Anomaly Status	No Issues
• Lost Item Problem Reports	No Issues (in backup)
• Time/Life Cycle	No Issues
• Critical Process Changes	No Issues
• Unexplained Anomalies	To Be Presented
• Safety, Quality, and Mission Assurance	No Issues
• Engineering/Information Topic	To Be Presented
• Nonstandard Work Summary	No Issues (in backup)

UNEXPLAINED ANOMALY FLIGHT DECK VIBRATION

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Observation
  - Astronaut Support Personnel (ASP) felt 3 light thumps while standing on Flight Deck seat #4
  - Occurred on March 28, 2001 at 21:30E
  - Two ASP's on Mid Deck did not feel same events
- Concern
  - Orbiter's integrity
- Discussion
  - Ascent switch list verification was in progress
  - Rain was present but no lightning advisories
  - Payload Bay doors closed, payload is not installed
  - FRCS room cleared for Comm activation
  - Standard power-up configuration- no active system testing

UNEXPLAINED ANOMALY FLIGHT DECK VIBRATION

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Actions taken per Contingency Procedure (S0018)
  - Witness statements taken for time of vibration
    - No Pad GSE move or heavy equipment operations
    - Verified seat #4 structurally sound
    - No mechanical, fluid, or pneumatic testing in progress
    - Following personnel did not feel or see anything abnormal
      - Forward Orbiter integrity clerks (OIC) and Space Craft Operator
      - Aft OIC and 6 Aft technicians (Aft closeout)
      - Two ASP's on Mid Deck
    - Firing Room Systems observed no anomalies
  - Forward Accelerometers Assemblies (AA) revealed no changes
  - Mains and AC currents did not deviate from baseline
  - Verified no activity on Ground and Launch Data Bus

UNEXPLAINED ANOMALY FLIGHT DECK VIBRATION

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Actions in work
  - Pad structure, Payload Bay, and Payload Changeout Room walkdown
  - Review of OI Voice recordings
- Most probable cause
  - Unknown
    - Note: Crew Module is a noisy environment
      - ie., Purge air, water coolant pumps, avionic fans
- Flight Rationale
  - Data and observations indicate no out of tolerance condition
  - No violations of hardware integrity

No constraint to STS-100 Launch Operations

INFORMATION ONLY
PCR DOOR SEAL CONTACT

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Observation
  - OV-105 right hand Payload Bay (PLB) door contacted Pad-A Payload Changeout Room (PCR) door seal
  - No damage to PLB or PCR doors

- Concerns
  - Clearance for Payload installation
  - Shuttle Element dynamic clearances (Orbiter-ET-SRB)
  - Incomplete retraction of Tail Service Mast (TSM)

INFORMATION ONLY
PCR DOOR SEAL CONTACT

Presenter:
Chris Connolly

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Ground Ops/04-05-01

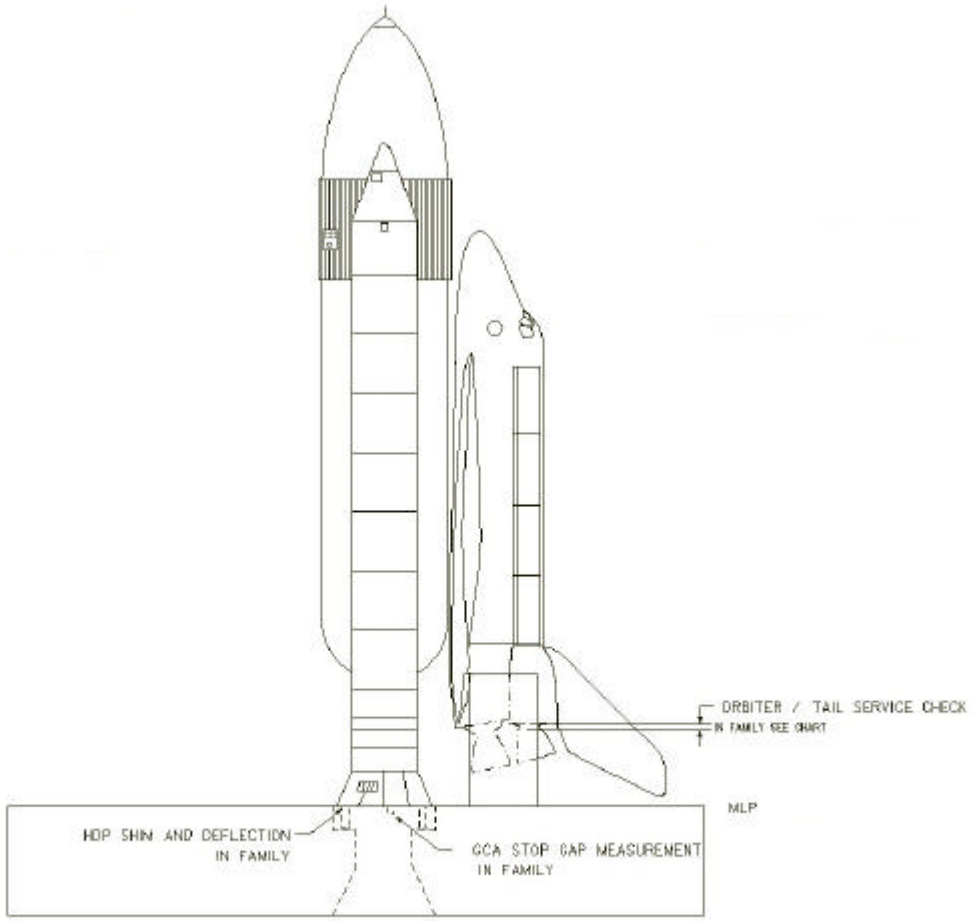
INFORMATION ONLY
PCR DOOR SEAL CONTACT

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Discussion
  - 1st time combination of MLP1, Pad-A, Lightweight ET, and OV-105 with no payload (Shuttle light)
  - Clearance of PLB door to PCR seal always minimal
  - Optics revealed PCR 0.4” low (relative to drawing)
  - TSM to orbiter aft optical measurements
    - STS-100 within historical database
    - Orbiter 0.35 inches high (high side of in-family)
    - All other Pad to orbiter umbilical mates nominal
  - No recent mods to Orbiter PLB doors, PCR, or MLP

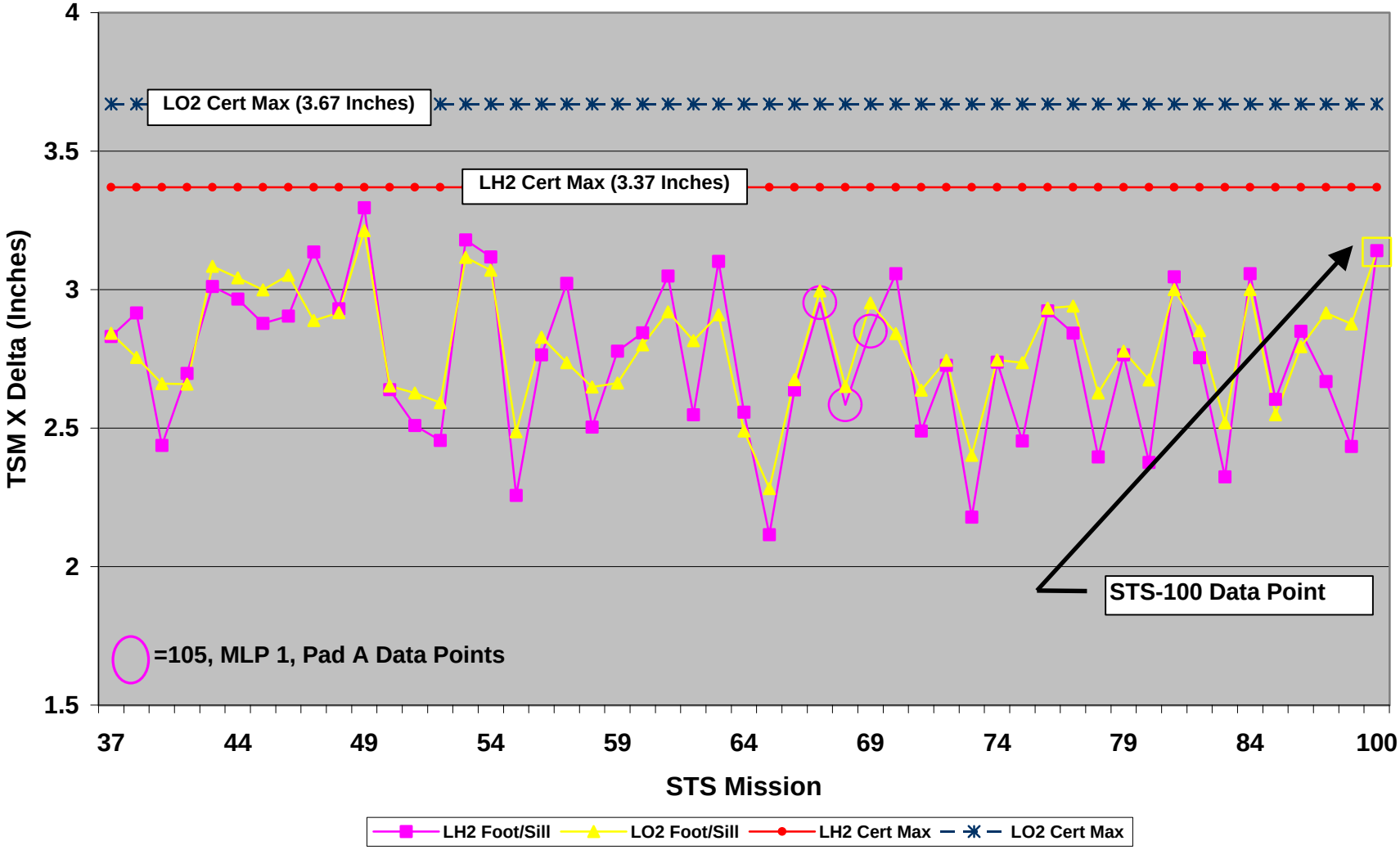
- Actions Taken
  - Fault Tree analysis performed
    - No vehicle concern based on TSM data
    - PCR structural inspections performed with no anomalies noted



STS-100 TSM / ORBITER CHECK

United Space Alliance

TSM X Survey Delta - Distance Sill is below Orbiter Foot Receptical



INFORMATION ONLY
PCR DOOR SEAL CONTACT

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Actions Taken (Cont'd)
  - Removed PCR door seal to open/close PLB doors
    - Seal prevents PCR contamination during launch
  - Optic measurements show discrepancies between actual vs ICD/drawing
    - PLB door length, PCR floor, Orbiter hatch elevations

- Actions in work
  - Obtain TSM to orbiter optics measurements post payload installation
  - Compare Pad support structure actual surveys to historical database
  - Resolve PCR/ICD discrepancies
  - These actions are no constraint to STS-100 processing and launch

INFORMATION ONLY
PCR DOOR SEAL CONTACT

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Risk Assessment
  - Clearance acceptable for
    - PLB door operations
    - Payload Integration operations
  - Payload Ground Handling Mechanism can compensate for any disparities and install payload
  - TSM measurements clear vehicle launch concerns

No constraint to STS-100 Launch Operations

STS-100 / OV-105
Launch Countdown Summary

OPR: S. Altemus (1-9302)

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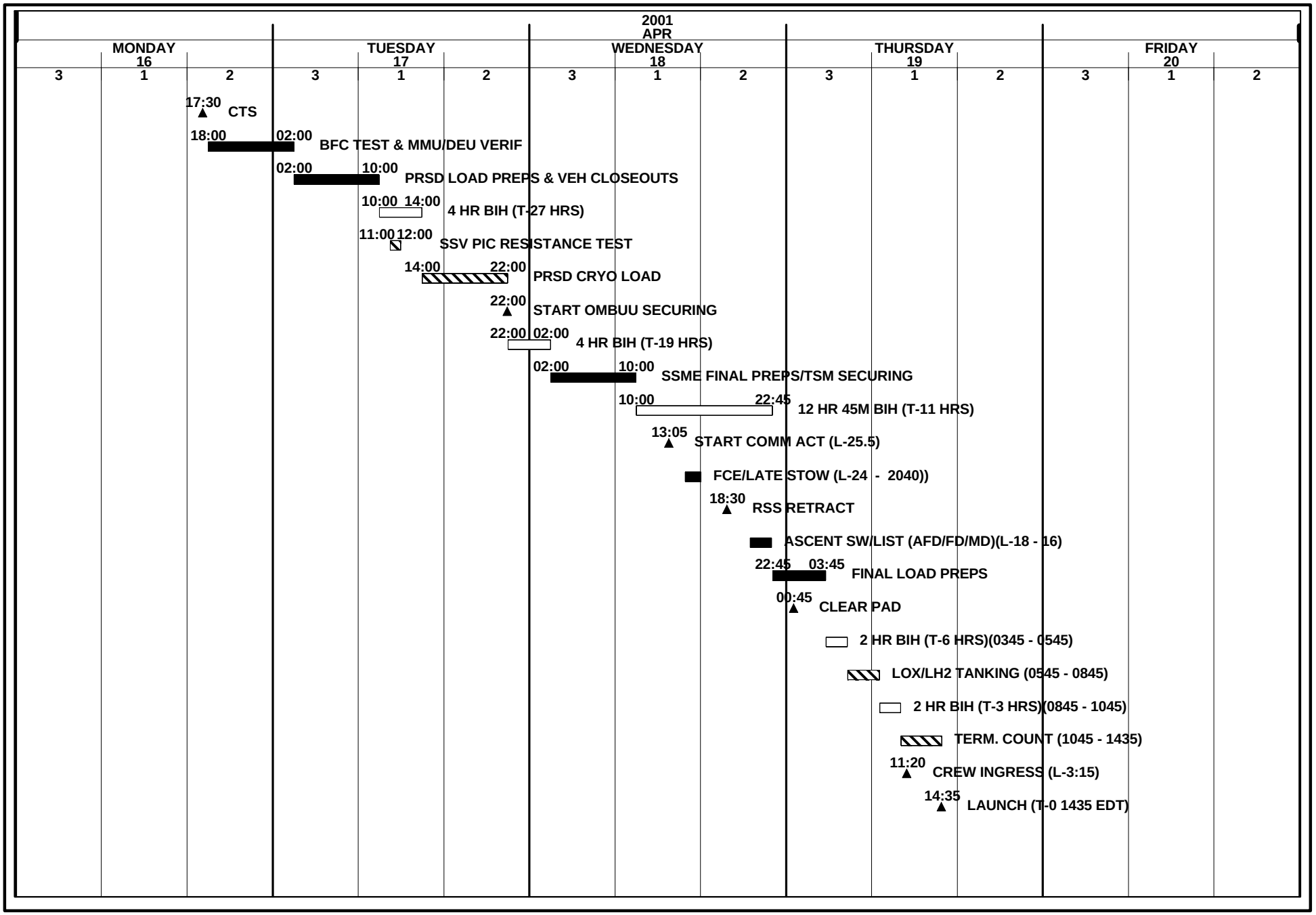

NOTE:
Actual scrub turnaround timelines will be determined realtime based on specific conditions encountered.

STS-100

LAUNCH COUNTDOWN TURNAROUND OPTIONS

OPR: S. ALTEMUS 1-0902

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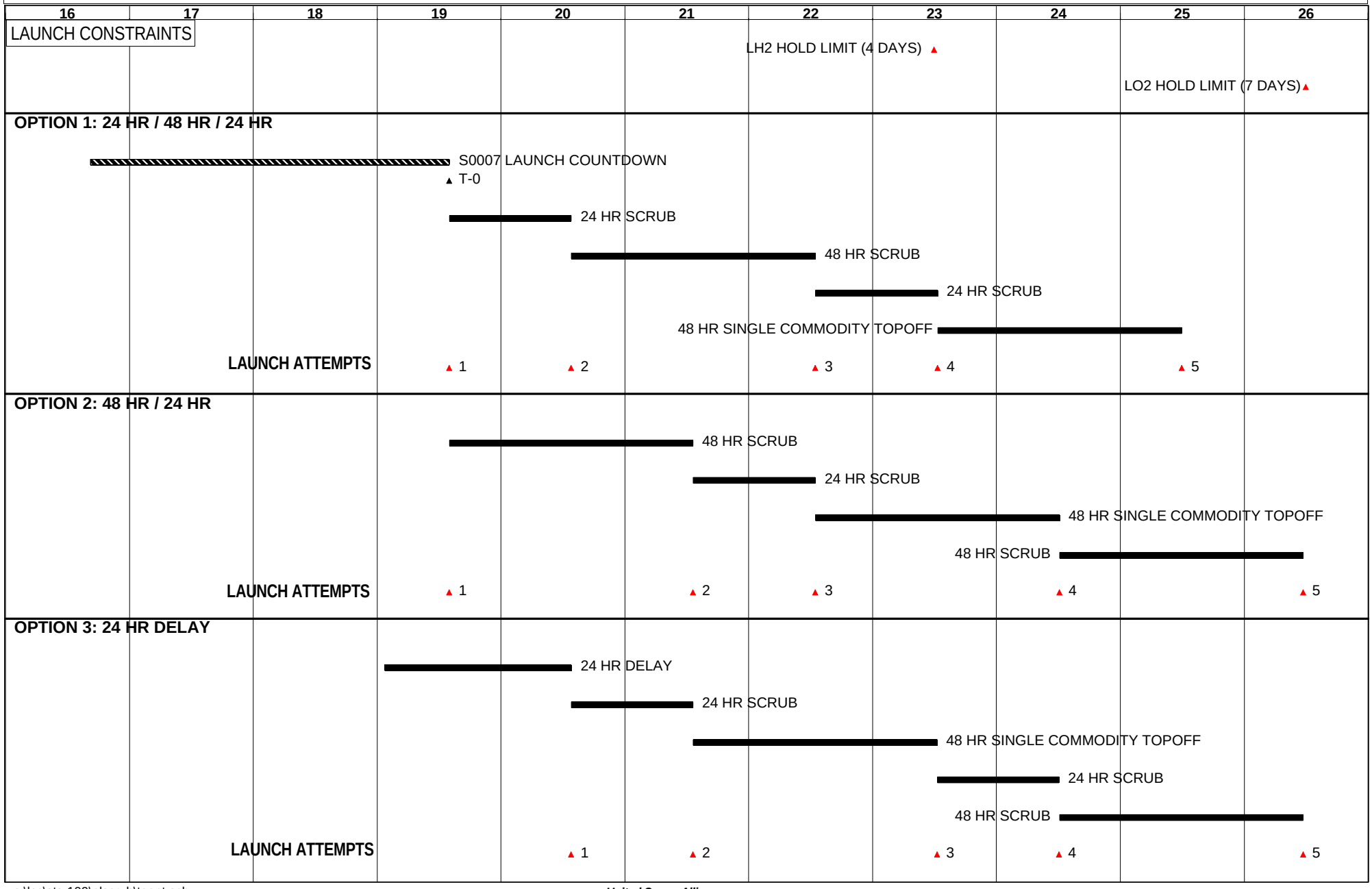


Kennedy Space Center
Shuttle Processing Team

STS-100 Readiness Statement

This is to certify that appropriate CoFR items from NSTS-08117 Appendices H and Q, Flight Preparation Process Plan, have been reviewed and dispositioned. Subject to completion of planned work and resolution of any identified constraints, KSC Shuttle Processing and Supporting Organizations are ready to support Launch Operations.

S/Charlie W. Murphy

Charlie W. Murphy
APM, Integrated Logistics,
USA.

S/Paul E. Adamek

Paul E. Adamek
APM, Ground Operations,
USA.

S/Michael Leinbach for

David A. King
Director of Shuttle Processing,
NASA

STS-100

FLIGHT READINESS REVIEW

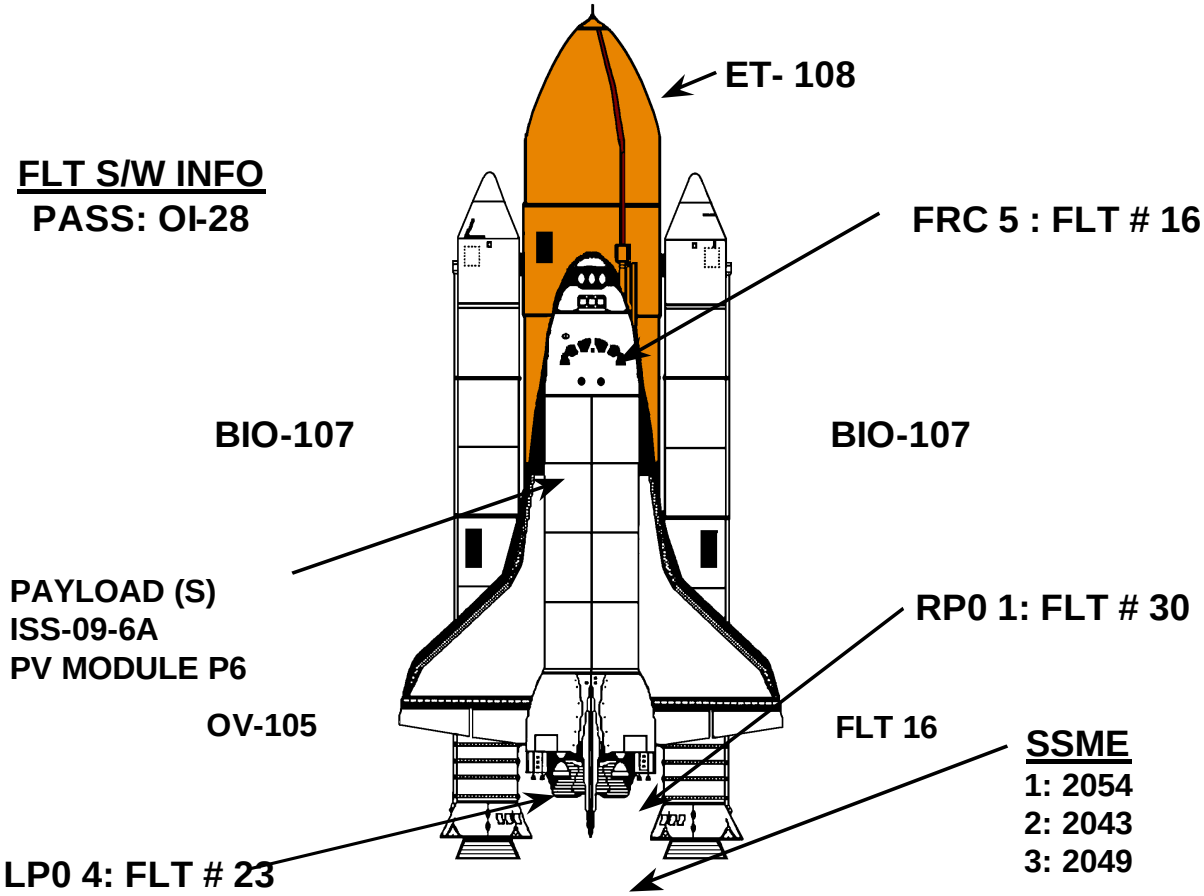
April 5, 2001

Ground Operations
Back-Up Charts

STS-100 INTEGRATED STACK CONFIGURATION: HARDWARE/ SOFTWARE

Presenter:
Eric Clanton

Organization/Date:
Ground Ops/04-05-01



United Space Alliance

NONSTANDARD WORK SUMMARY

Presenter:
Eric Clanton

Organization/Date:
Ground Ops/04-05-01

Chit	Description	ECD
• Orbiter		
J5189	MAGR-S3S Fault Log Collection	
J5305	Opt Survey of the Orbiter Aft Camera Mounts and Ods Relative Pos	
J5340R1	MPS Engine Mounted Heat Shield Elongated Holes Inspection	
J5360	Gas Beam to Passive Fram Interface Plate and SASA FSE Fit Check	
J5370A	R&R of SSOR for OV-103, OV-104, and OV-105	
J5378	Interim Measurements of Keel Bridge Fittings	

NONSTANDARD WORK SUMMARY

Presenter:
Eric Clanton

Organization/Date:
Ground Ops/04-05-01

Chit	Description	ECD
• Orbiter - (Cont'd)		
J5381	Air Flow Verification of Ducting Mod, Orifice Installation	
J5388	Light Weight Pallet Inspection	
J5389A	Vehicle Hydraulic Quiescent Flow Measurement	
J5391	Cannibalization of OSVS from OV-105 To Support OV-104	
J5410	Wrist Camera Calibrations	
J5411	Inspection of ODS Centerline Camera Harnesses	

NONSTANDARD WORK SUMMARY

Presenter:
Eric Clanton

Organization/Date:
Ground Ops/04-05-01

Chit	Description	ECD
• Orbiter - (Cont'd)		
J5414	Purging/Moisture Sampling of Water Spray Boiler GN2 HP Sys	
J7008	Add OMRS Rqmt. Mission Unique List File 3 Adj Bent Pinc/O	
J7009	TCS OMRSD Requirements	
K5398A	Orbiter Waste System Drain and Service (Post Supa Flights)	

NONSTANDARD WORK SUMMARY

Presenter:
Eric Clanton

Organization/Date:
Ground Ops/04-05-01

Chit	Description	ECD
• Orbiter – (Cont'd)		
J4990R4	Torque Re-check of Body Flap Actuator Attach Fitting Bolts	Comp
J5368	Pressure Test in Support of the Condensate Separation H/W	Comp
J7007	PCS Test Section Fit Check	Comp

NONSTANDARD WORK SUMMARY

Presenter:
Eric Clanton

Organization/Date:
Ground Ops/04-05-01

Mod	Description	ECD
• ET		
FEC KET-0069	Intertank Foam Venting	

LOST ITEM PROBLEM REPORTS

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

Lost Items Not Found (2 Total)

Summary/Conclusion for all LAF PR's

- A thorough search of each area was unsuccessful in finding/retrieving the lost items
- System Engineering evaluations have concluded no adverse effect on Orbiter system operations

Midbody

- PR -LAF-5-16-0309: Washer lost during ECL-5-16-285
  - Weight: 0.78 grams
  - Size: 0.6 in dia
  - Location: Bay 4 starboard below wire tray

LOST ITEM PROBLEM REPORTS

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

AFT FOD

- PR- LAF-5-16-0311: Tip of phenolic pick broke off
  - Weight: 12.28 milligrams
  - Size: 0.2 in
  - Location: Remote possibility inside OMS Oxidizer cross feed line

GROUND LAUNCH SEQUENCER

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

Ground Launch Sequencer Configuration for STS-100

- GLSDD (KLO-82-0071A) Rev 8, Change B, March 2001

SSID / OMRS	Description and Remarks
• Mask	
ECL-40	FC1&2 Payload Heat Exchanger Flow Rate
CT-01	TACAN 1 Range Built-in Status Word 2 Bit 4
CT-01	TACAN 2 Range Built-in Status Word 2 Bit 4
PAY-02	Payload Auxiliary RPC A & B - ON
PAY-03	Payload Aft Main B & C Power – ON

- Bypass - None

FUEL CELL RUNTIME

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Fuel Cell (FC) Runtime Contingency
  - Present Runtime Hours
    - FC 1 s/n 109 0
    - FC 2 s/n 116 0
    - FC 3 s/n 121 1182
  - Planned FC runtime usage - 30 hours
    - 11 day mission + 2 Weather Contingency + FC Start/Landing
  - Available Contingency Runtime
    - FC 1 2258 hrs
    - FC 2 2258 hrs
    - FC 3 1076 hrs

UNEXPLAINED ANOMALIES

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Closed – (3)
  - * PR UA-5-A0029: OPS 2 Recorder Failed to go into Reverse
  - * UA-5-16-0087: EMU 2 Waste Water Valve Talkback Error
  - * UA-5-16-0088: MLG Right Outboard Tire Pressure Failed Low
- Deferred – (1)
  - * PR UA-5-A0016: Vernier Thruster L5D Temp Erratic
- Open – (0)
  - * Presented at previous Readiness Review – In Backup Charts

UNEXPLAINED ANOMALIES MLG RIGHT OUTBOARD TIRE PRESSURE FAILED LOW

Presenter: Chris Connolly

Organization/Date: Ground Ops/04-05-01

- Observation
  - 10 days into STS-97 mission, MLG right outboard tire pressure
    - Dropped from 332 psia to off scale low 232 psia
    - Redundant pressure read nominal
- Concerns
  - Loss of redundant tire pressure measurement
- Actions Taken
  - KSC troubleshooting unable to repeat problem
    - Nominal readings from separation harness to signal conditioner
    - No dropouts observed during wiggle test
    - Detailed inspection found no discrepancies
    - New wheel assembly and separation harness installed

UNEXPLAINED ANOMALIES MLG RIGHT OUTBOARD TIRE PRESSURE FAILED LOW (CONT'D)

Presenter: Chris Connolly

Organization/Date: Ground Ops/04-05-01

- Most Probable Cause
  - Intermittent connection or damage at the tire separation harness
- Flight Rationale
  - Tire integrity verified by long term decay check
  - Failure of one or both measurements is not a constraint to launch if decay rates within acceptable limits (Crit 3/3)
  - Wheel assemblies and separation harnesses replaced every flow
- Risk Assessment
  - Very Low (redundant measurement, long term decay checks)
  - No risk to mission success or flight and crew safety

UNEXPLAINED ANOMALIES OPS2 RECORDER FAILURE	Presenter: Chris Connolly
	Organization/Date: Ground Ops/04-05-01

- Observation
  - During STS-99 flight, OPS2 Recorder failed to rewind via uplink command
  - Anomaly occurred twice in flight (16 hours apart)

- Concerns
  - Loss of recording redundancy for OI and PCM data

UNEXPLAINED ANOMALIES
OPS2 RECORDER FAILURE (CONT'D)

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Actions Taken In-Flight
  - Confirmed valid issuance and receipt of up-link commands
  - Subsequent OPS2 recorder commands, including reverse,were successfully executed for remainder of mission
  - Playback command was used to reposition tape to beginning
  - No prior occurrence of this anomaly
  - OPS2 recorder troubleshooting was unable to repeat the anomaly
    - Performed record-stop-rewind-stop sequence 10 times
    - No voltage/resistance changes when wire harness flexed
    - OPS2 recorder connectors inspected, no discrepancies
    - Reissued recorder command sequence another 10 times

UNEXPLAINED ANOMALIES
OPS2 RECORDER FAILURE (CONT'D)

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Most Probable Cause
  - Logic time out error within OPS2 recorder command register which prevented the direction bit to be set
- Flight Rationale
  - OPS1 recorder provides redundancy to OPS2 recorder
  - Proven in-flight workaround using playback command to rewind
- Risk Assessment
  - No risk to Mission success or Flight and Crew safety

UNEXPLAINED ANOMALIES THRUSTER L5D OXIDIZER INJECTOR TEMP ANOMALY	Presenter: Chris Connolly
	Organization/Date: Ground Ops/04-05-01

- Observation
  - Vernier Thruster (S/N-102) L5D oxidizer injector temperature measurement V42T2525C exhibited erratic behavior during STS-68 mission

- Concerns
  - Inadvertent operation of RCS Redundancy Management to enunciate erroneous Oxidizer Leakage from this Vernier Thruster, resulting in deselection of L5D, and ultimately resulting in loss of all Vernier thruster usage

UNEXPLAINED ANOMALIES THRUSTER L5D OXIDIZER INJECTOR TEMP ANOMALY (CONT'D)

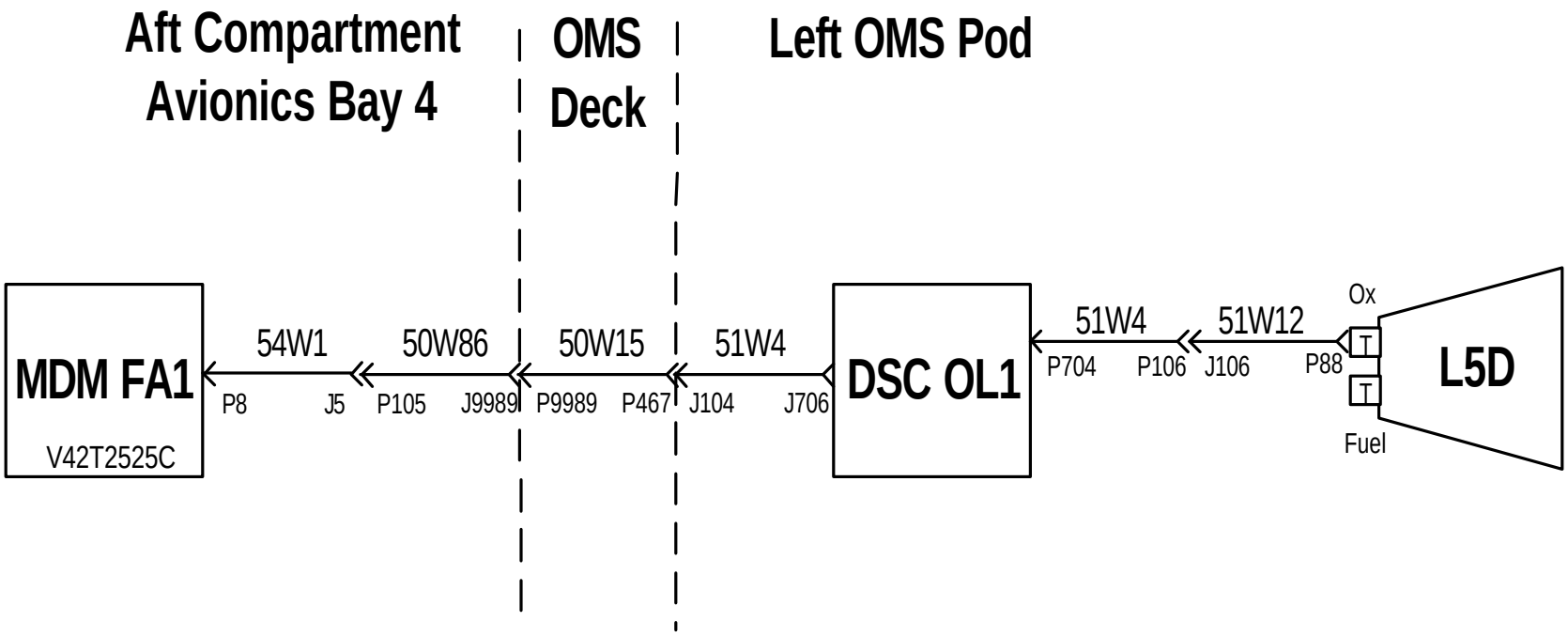
Presenter: Chris Connolly

Organization/Date: Ground Ops/04-05-01

- Discussion - Actions Taken
  - STS-67 Flow
    - Troubleshooting performed identified the most probable cause to be a failure in circuitry internal to thruster L5D
      - Thruster was replaced with s/n 461
  - STS-67 Mission
    - Erratic temperature measurement behavior returned
    - BITE test performed during flight on MDM FA1 with nominal results

UNEXPLAINED ANOMALIES THRUSTER L5D OXIDIZER INJECTOR TEMP ANOMALY (CONT'D)	Presenter: Chris Connolly
	Organization/Date: Ground Ops/04-05-01

L5D Oxidizer Injector Temperature Block Diagram



UNEXPLAINED ANOMALIES THRUSTER L5D OXIDIZER INJECTOR TEMP ANOMALY (CONT'D)	Presenter: Chris Connolly
	Organization/Date: Ground Ops/04-05-01

- Discussion - Actions Taken (Cont'd)
  - STS-69 Flow, detailed troubleshooting was performed
    - Visual inspection for any damage to all accessible orbiter aft compartment wiring showed no anomalies
    - Wire flexing of individual wires supporting temperature measurement between OMS pod interface and MDM FA1 showed no fluctuations
    - Hi-pot testing on harness between OMS pod and MDM FA1 detected no anomalies
  - STS-69 Mission, no erratic temperature behavior detected

UNEXPLAINED ANOMALIES THRUSTER L5D OXIDIZER INJECTOR TEMP ANOMALY (CONT'D)

Presenter: Chris Connolly

Organization/Date: Ground Ops/04-05-01

- Discussion - Actions Taken (Cont'd)
  - STS-72 Flow
    - Troubleshooting at L5D thruster to pod electrical interface detected no anomalies
      - Wire flex test: no anomalies
      - Resistance test across oxidizer temperature sensor verified
      - Excitation voltage from Dedicated Signal Conditioner verified
      - Thruster heated to simulate flight thermal conditions: no anomalies
    - Pod was removed and sent to the HMF in support of Quad Check Valve (CV401) replacement
      - Additional troubleshooting for oxidizer temperature measurement performed and no anomalies detected

UNEXPLAINED ANOMALIES THRUSTER L5D OXIDIZER INJECTOR TEMP ANOMALY (CONT'D)

Presenter: Chris Connolly

Organization/Date: Ground Ops/04-05-01

- Discussion - Actions Taken (Cont'd)
  - STS-72 and STS-77 Missions showed L5D oxidizer injector temperature measurement output was nominal
  - STS-89 Pod OMDP
    - Extensive electrical testing and wire flexing was performed
      - Flexing of cable 51W4 and monitoring resistance from P704 pin 31 to P106 pin 38 (sensor excitation path), recorded a 0.001 ohm fluctuation
      - Could not repeat fluctuation when test was reperformed to localize the cause
    - L5D was replaced due to Pc tube flushing issue

UNEXPLAINED ANOMALIES THRUSTER L5D OXIDIZER INJECTOR TEMP ANOMALY (CONT'D)	Presenter: Chris Connolly
	Organization/Date: Ground Ops/04-05-01

- Most Probable Cause
  - Intermittent electrical contact as a result of a faulty splice point, connector crimp or recessed pin
- Flight Effects
  - If thruster L5D oxidizer injector temperature measurement is erratic/failed low, RCS Redundancy Management (RM) would enunciate a failed leak and deselect L5D resulting in loss of all Vernier thruster usage
  - Will use fuel sensors to monitor both fuel and oxidizer due to close proximity

UNEXPLAINED ANOMALIES THRUSTER L5D OXIDIZER INJECTOR TEMP ANOMALY (CONT'D)

Presenter:
Chris Connolly
Organization/Date:
Ground Ops/04-05-01

- Flight Effects (Cont'd)
  - General Memory (Pre-Approved) software patch would be uplinked into flight software to lower RCS RM oxidizer injector temperature leak limit from 130^{o} F to 0^{o} F
    - Allows deselection of failed thruster and subsequent reselection of all Vernier thrusters for usage
    - Oxidizer injector temperature sensors will not be used for leak detection
  - Visibility to the crew of this condition would be evident by the erratic behavior of oxidizer temperature measurement and low-bias when compared with fuel injector temperature measurement
    - Available on PFS and BFC GNC SYS SUMM1 pages and Caution & Warning

UNEXPLAINED ANOMALIES
EMU 2 WASTE WATER VALVE TALKBACK ERROR

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Observation
  - During STS-97 mission, EMU 2 waste water valve OI indication changed from close to open unexpectedly
  - Airlock panel AW82D switch DS4 indicated open
- Concerns
  - Potential failure to close EMU 2 waste water valve
- Discussion
  - DS4 switch may of been bumped to cause initial open indication
    - Three position, two pole momentary switch located on AW82D
  - EMU 2 waste water valve
    - Used to drain EMU 2 cooling water into Orbiter waste system
    - Magnetically latching solenoid valve

UNEXPLAINED ANOMALIES
EMU 2 WASTE WATER VALVE TALKBACK ERROR (CONT'D)

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Actions Taken in Flight
  - Switched EMU 2 waste water valve to close position
    - OI and DS4 talkback remained in open
    - No valve cycling noise occurred
  - 30 minutes later, cycled valve open then close
    - OI and DS4 talkback indicated closed
    - Heard valve cycle to close
  - EMU 2 waste water valve not cycled for remainder of mission

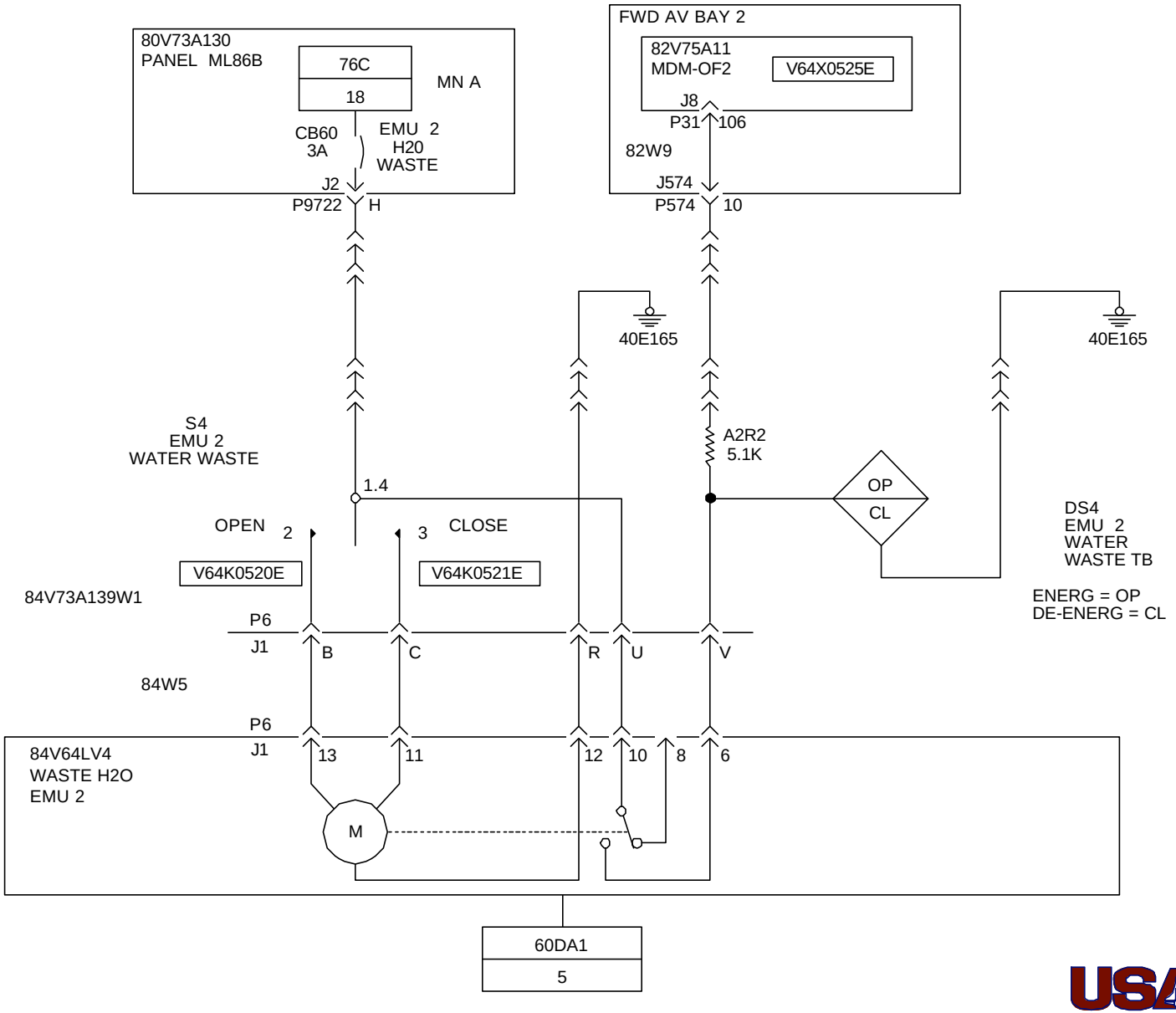
UNEXPLAINED ANOMALIES
EMU 2 WASTE WATER VALVE TALKBACK ERROR (CONT'D)

Presenter:
Chris Connolly

Organization/Date:
Ground Ops/04-05-01

- Actions Taken on Ground
  - No anomalies noted during troubleshooting of valve and associated wiring
    - Ground paths, resistance and voltage checks good
      - Wiggled wires during checks
    - Visual inspections of connectors found no discrepancies
    - Valve cycled several times with good talkback/audible click
    - EMU 1 and EMU 2 waste water valve cycling signature same

- Most Probable Cause
  - Intermittent open in closing circuit copper path
    - Consistent with on-orbit troubleshooting/problem description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PANEL ML86B
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MN A
CB60
3A
EMU 2
H20
WASTE
J2
P9722
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82V75A11
MDM-OF2
V64X0525E
J8
P31
106
82W9
J574
P574
10
40E165
40E165
S4
EMU 2
WATER WASTE
1.4
A2R2
5.1K
OP
CL
DS4
EMU 2
WATER
WASTE TB
ENERG = OP
DE-ENERG = CL
OPEN
2
3
CLOSE
V64K0520E
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UNEXPLAINED ANOMALIES EMU 2 WASTE WATER VALVE TALKBACK ERROR (CONT'D)	Presenter: Chris Connolly
	Organization/Date: Ground Ops/04-05-01

- Flight Rationale
  - If EMU 2 waste water valve failed open
    - EMU regulator can isolate downstream waste valve
  - If EMU 2 waste water valve failed closed
    - SCU1 gang connector could be used for both EMU1 and 2

- Risk Assessment
  - Post-flight testing verified proper valve and talkback performance
  - Contingency plan acceptable
  - No risk to mission success or flight and crew safety